DRAFT

NEXRAD Product Improvement

Open Radar Data Acquisition (ORDA)

Maintenance Plan

OSTPLN-ORDA-011

August 2002

NWS Office of Science and Technology

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1 Introduction

The purpose of this maintenance plan is to establish the process for achieving reliability, maintainability, and availability objectives.

1.1 Maintenance Plan Contents

Section 1 contains the Introduction, an overview of the plan's contents, definition of terms, and milestones for maintenance planning.

Section 2 describes the maintenance concept. More precisely, it introduces the maintenance levels – Operational Site and Depot – and then describes in detail the roles and available resources for each maintenance function.

Section 3 gives preliminary MTBF results for the ORDA retrofit equipment and compares it to the obsolete equipment. Subsections describe how the MTBF is calculated, and a preliminary Provisioning Parts List for the ORDA retrofit equipment used to calculate the MTBF is provided.

Section 4 describes the maintainability requirements for the Operational Site- and Depot-maintenance levels.

Section 5 justifies the Contractor's approach towards availability.

1.2 Terminology

Maintenance function – An activity that performs Unit-level or Depot-level maintenance.

Obsolete Equipment – Existing legacy RDA equipment that will be replaced by ORDA.

ORDA Retrofit Equipment – New Commercial Off-The-Shelf (COTS) equipment that will replace the obsolete equipment.

1.3 Maintenance Plan Milestones

April 2003	Provisioning conference – deliver provisioning parts list information per DD-Form 1949-1 for i-Caps sparing modeling
April 2004	Contractor, NLSC, NRC, and agencies' focal points will receive sparing recommendations from Government (Silver Springs, MD)
June 2004	NLSC will begin replacement part stock-fill

2 Maintenance Concept

The WSR-88D employs a two-level maintenance concept: unit- (i.e., operational site) and depot-level. **Figure 2-1** illustrates the support infrastructure for the two-level maintenance concept.

The maintenance plan considers unit-level maintenance to be Operational Site-level maintenance. Subsequent sections discuss the services and resources provided by operational site.

Depot-level maintenance is defined as (1.) NLSC, or National Logistics Service Center, (2.) NRC, or National Reconditioning Center, (3.) ROC Hotline, and (4.) Regional/MAGCOM Support. Subsequent sections discuss the services and resources provided by depot-level maintenance functions.

Component suppliers supply goods and services to the NLSC and NRC.

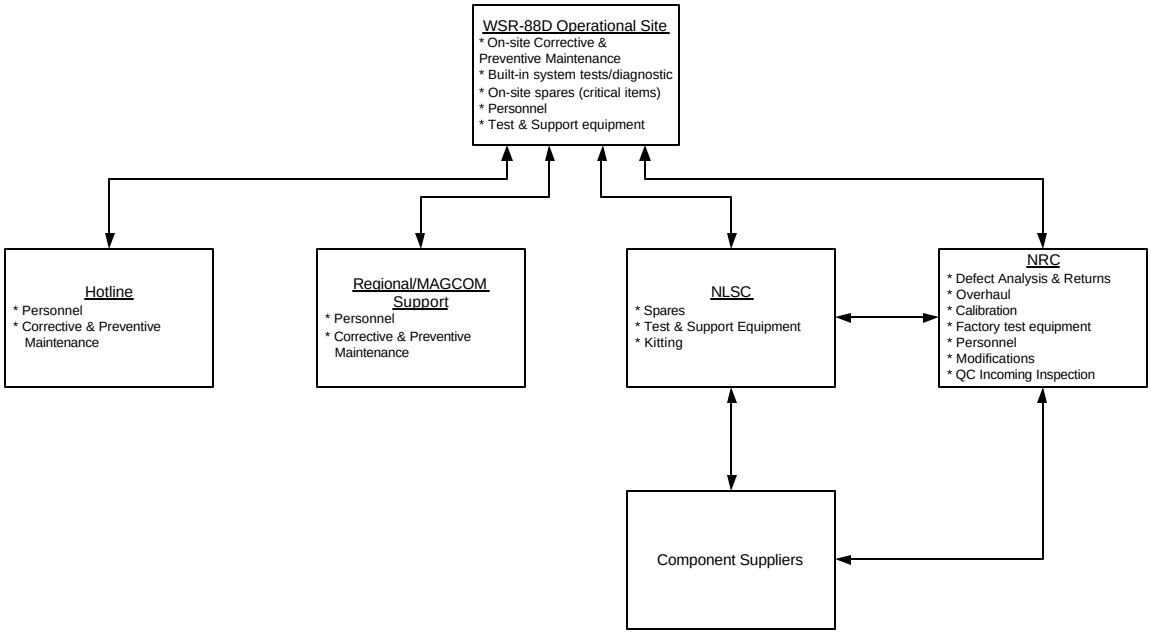

Figure 2-1. WSR-88D Support Infrastructure.

2.1 Operational Site-Level Maintenance

2.1.1 On-site Corrective & Preventive Maintenance

The operational site is responsible for performing on-site maintenance after acceptance. On-site maintenance categories are (1.) corrective maintenance, and (2.) preventive maintenance.

On-site corrective maintenance steps are (1.) detecting a failure and confirming the defective LRU with or without the assistance of the Hotline or Regional/MAGCOM

Support, (2.) documenting parameters, settings, firmware/software/OS versions, and system health measurements, (3.) removal and replacement of defective items with a spare, and (4.) calibration and checkout (e.g., verifying system health measurement improvements).

On-site preventive maintenance steps are (1.) obtaining test equipment, tools, and replacement parts in advance, (2.) documenting parameters, settings, firmware/software/OS versions, and system health measurements, (3.) visually inspecting and probing the system, (4.) performing scheduled preventive services, and (4.) calibration and checkout (e.g., verifying system health measurement improvements).

For certain designated items, on-site maintenance personnel will replace multiple LRUs at the subassembly level. For these designated subassemblies, it will be the responsibility of the NRC to validate the defective LRU and repair or replace it.

Corrective and preventive maintenance activities, schedules, and instructions are prescribed in the WSR-88D technical manuals provided by ROC's Product Documentation Team.

The operational site is responsible for returning defective or suspect LRUs (line replaceable units) to the NRC.

2.1.2 On-site Spares (Critical Items)

To protect the system's availability, the operational sites will be responsible for maintaining a certain number of specified spares (i.e., replacement parts) on-site. The Contractor will assist the Government with sparing. However, based upon the Government's sparing model, the Government will make the final determination on sparing level.

2.1.3 Personnel

The operational sites will continue to use existing on-site maintenance personnel to maintain the WSR-88D. Personnel will be capable of performing diagnosis and repairs using (1.) technical manuals, (2.) training, (3.) Hotline, and (4.) Regional/MAGCOM support as required.

NWS and Air Force Training Centers will train existing on-site maintenance personnel on theory of operation, troubleshooting, and maintenance procedures.

2.1.4 Test & Support Equipment

The operational sites will continue to use existing test and support equipment. They do not require new test and support equipment.

2.1.5 Built-in System Tests/Diagnostics

The ORDA equipment will have built-in system tests and diagnostics that will allow on-site maintenance personnel to pinpoint faulty LRU's (line replaceable units) with the following confidence:

Fault isolation to 1 LRU: 80% of all encountered faults

Fault isolation to 3 or less LRU's: 95% of all encountered faults

Specifics about built-in system tests and diagnostics will be discussed in subsequent sections.

2.2 Depot-Level Maintenance

2.2.1 NLSC, National Logistics Service Center

2.2.1.1 Spares

The NLSC supplies spares (i.e., replacement parts) to the operational sites and NRC. The NLSC receives spares either from (1.) component suppliers for new or repaired/ overhauled parts, or (2.) NRC for repaired/overhauled parts. The Contractor will provide information to order spares.

2.2.1.2 Test & Support Equipment

The NLSC supplies (1.) calibrated test equipment and (2.) shared support equipment for corrective or preventive maintenance to operational sites and the NRC. They do not require new test and support equipment.

2.2.1.3 Kitting

The NLSC builds and ships kits. Kitting can involve (1.) receiving, separating, and repacking bulk items into individual packages and shipping them to sites, or (2.) receiving individual packages from various sources, packing them into a bulk package, and shipping them to sites. They will not do any kitting for ORDA.

2.2.2 NRC, National Reconditioning Center

2.2.2.1 Defect Analysis & Returns

NRC will receive and analyze all defect returns (and suspected defect returns) generated by the operational sites. NRC will validate whether (1.) the part has a fault, or (2.) no trouble found.

For no trouble found parts, NRC will calibrate, certify, re-package, and give them to NLSC to re-stock as spares.

For faulty parts, NRC will either (1.) make repairs, (2.) send it out for repairs, (3.) obtain a warranty repair or replacement, or (4.) condemn the part. RSIS and its amenable vendors will give the NRC documentation to diagnose and service parts.

2.2.2.2 Overhaul

NRC will overhaul/repair and validate the success of in-house overhauls/repairs. NRC will internally decide whether or not to repair or overhaul a part in-house. The Contractor will give the NRC documentation to diagnose and service parts.

2.2.2.3 Calibration

NRC calibrates all in-house factory test equipment, test and support equipment warehoused by NLSC, and parts repaired in-house. The Contractor will give the NRC documentation to diagnose and service parts.

2.2.2.4 Factory Test Equipment

NRC maintains factory test equipment used to analyze and repair all defect returns. The Contractor will give NRC documentation to upgrade factory test equipment for ORDA.

2.2.2.5 Personnel

NRC will continue to use existing personnel to perform incoming inspection, diagnosing returns from operational sites, and servicing parts. Personnel will be capable of performing diagnosis and repairs using (1.) technical manuals and (2.) training.

Existing NRC personnel will be trained on theory of operation, troubleshooting, and maintenance procedures.

2.2.2.6 Modifications

NRC is capable of modifying equipment and components. No modifications to ORDA components are required.

2.2.2.7 QC Incoming Inspection

NRC performs Quality Control (QC) incoming inspection of received goods for NLSC. The Contractor will give the NRC documentation to inspect parts.

2.2.3 Hotline

2.2.3.1 Personnel

The ROC (RADAR Operation Center) Hotline is a 7 day 24 hour supportive function for the operational sites. Existing Hotline personnel will be trained on theory of operation, troubleshooting, and maintenance procedures.

2.2.3.2 Corrective & Preventive Maintenance

Personnel will be capable of performing off-site diagnosis using (1.) technical manuals, (2.) raw data for base products, and (3.) real-time built-in tests and diagnostics electronically transmitted to the Hotline's location.

As required, personnel will visit the operational site to perform diagnosis and repairs using (1.) technical manuals, and (2.) training.

2.2.4 Regional/MAGCOM Support

2.2.4.1 Personnel

Regional/MAGCOM Support teams can be called in to help operational sites diagnose and repair the system. Existing Regional/MAGCOM Support teams will be trained on theory of operation, troubleshooting, and maintenance procedures.

2.2.4.2 Corrective & Preventive Maintenance

Personnel will be capable of performing on-site diagnosis and maintenance using (1.) technical manuals, and (2.) training.

2.3 Contractor

The Contractor will supply the ORDA retrofit equipment and software. The Contractor will provide the following:

(1.) Train the trainers (training courses will be conducted by Warning Decision Training Branch)

(2.) Provide technical manuals for the ORDA retrofit equipment

(3.) Provide an obsolescence mitigation strategy that will give consideration to (A.) alternative, interchangeable part, (B.) an empirically proven upgrade path, or (C.) lifetime buy recommendation

(4.) List manufacturers for warranty repair or replacement of returned parts

(5.) Provide documentation and procedures pertinent to troubleshooting and repairing

3 Reliability Analysis

3.1 Mean Time Between Failure (MTBF)

3.1.1 Goal

The Contractor will validate the reliability of the design by comparing the Mean Time Between Failure (MTBF) between the obsolete equipment and ORDA retrofit equipment. The process for generating MTBF is illustrated in **Figure 3-1**. The MTBF results are presented in **Table 3-1**.

3.1.2 Preliminary Results For MTBF

The ORDA NEXRAD Product Improvement project will make approximately 94 Line Replaceable Units (LRUs) obsolete by replacing them (i.e., retrofitting all WSR-88D sites) with readily available Commercial Off-The-Shelf (COTS) equipment. **Table 3-1** gives the MTBF (Mean Time Between Failure) comparison between the existing, obsolete equipment and the proposed COTS retrofit equipment. **Table 3-1** further makes this comparison for NWS non-redundant and DOT redundant (a.k.a. FAA redundant) configurations. Preliminary MTBF analysis indicates that the ORDA retrofit equipment will significantly improve the WSR-88D's reliability.

Under the column heading "Obsolete RDA Equipment," the MTBF (Mean Time Between Failure) for the 94 obsolete LRUs is presented.

The new equipment that will replace the obsolete equipment is called "ORDA Retrofit Equipment." Under the column heading "ORDA Retrofit Equipment," the MTBF calculations include a CD Read/Write device but do not include a floppy disk drive.

	MTBF, Obsolete RDA Equipment	MTBF, ORDA Retrofit Equipment
NWS (non-redundant)	1,000 hours	10,00 hours
DOT Redundant (FAA redundant)	2,000 hours	20,000 hours

Table 3-1. Obsolete RDA equipment MTBFs versus ORDA Retrofit Equipment

There is a third configuration known as the NWS partially-redundant configuration. It is not presented in **Table 3-1** because it is not defined in the System Specification, NEXRAD Technical Requirements, 2810000D.

3.1.2.1 Guidance For Calculating MTBF

The main points about the MTBF generation process are:

- MTBF for obsolete equipment is obtained from NWS' EMRS database (actual field data),
- MTBF for ORDA retrofit equipment is either obtained from vendors or NWS' EMRS database (actual field data) is used as a reasonable substitute,
- Only two configurations, NWS (assumed non-redundant) and DOT Redundant (a.k.a. FAA redundant) are considered because these are the only two configurations specified in System Specification (NEXRAD Technical Requirements) 2810000 revision D, and
- Per MIL-HDBK-470A, MTBF = 1 / failure rate, or $1 / \lambda$, and
- Per MIL-HDBK-470A, $1 / \lambda_{system} = \Sigma\ 1 / \lambda_{subsystem}$
- The formula for reliability, R, is $R = e^{-\lambda t} = e^{-(1/MTBF)\,t}$

3.1.2.2 Process For Calculating MTBF

Figure 3-1 is the flow chart for the process of computing MTBF. This is the mathematical strategy used by the Contractor to compute the obsolete equipment's MTBF and ORDA retrofit equipment's MTBF.

The subsequent section present the mathematical proof for the Contractor's MTBF solution.

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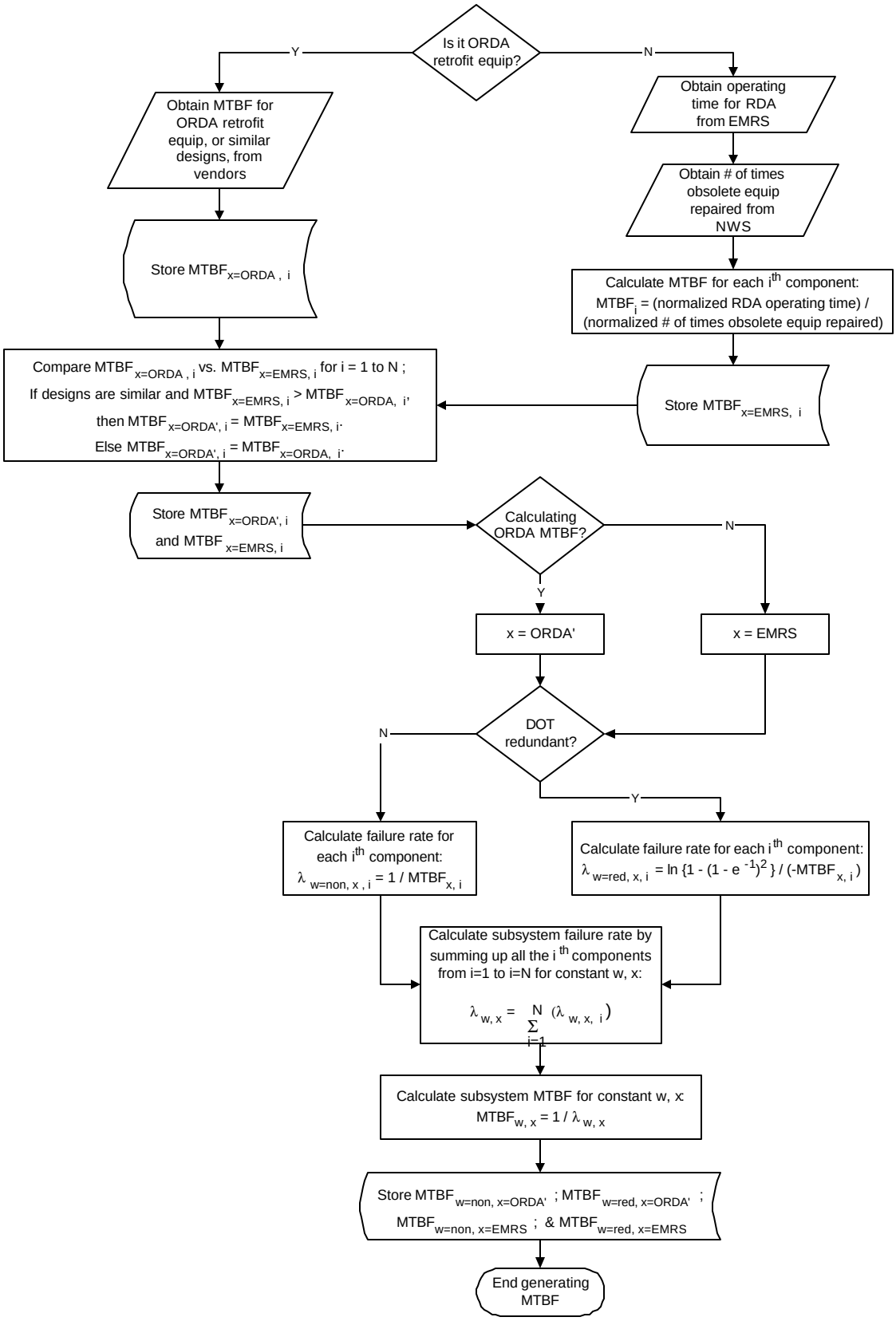

Figure 3-1. Flowchart for computing MTBF.

3.1.2.3 Proof For Calculating MTBF

Non-redundant systems are modeled as subsystems in series; therefore the reliability of a non-redundant system comprised of subsystems A, B, and C is:

$$R_{non\ system} = (R_A)(R_B)(R_C)$$

Redundant systems are modeled as subsystems in parallel; therefore, the reliability of a redundant system comprised of subsystems A, B, and C in parallel is:

$$R_{red\ system} = 1 - (P_A)(P_B)(P_C),$$

Where P_i is the probability of failure of subsystem i, and $P_i = 1 - R_i$

NOTE: $P_i + R_i = 100\%$

Therefore, $R_{red\ system} = 1 - (1 - R_A)(1 - R_B)(1 - R_C)$

If $R_A = R_B = R_C = R$, then $R_{red\ system} = 1 - (1 - R)^3$

In general, $R_{red\ system} = 1 - (1 - R)^N$ when $R_A = R_B = \ldots = R_N$ and N is the number of systems in parallel (for a typical redundant system, N = 2)

In general, to calculate the MTBF of a redundant system with N subsystems in parallel and $R_A = R_B = \ldots. = R_N$; therefore, $MTBF_A = \ldots = MTBF_N = MTBF_{subsystem}$

$$R_{red\ system} = e^{-(1\ /\ MTBF_{red\ system})\ t} = 1 - (1 - e^{-(1\ /\ MTBF_{subsystem})\ t})^N$$

If $MTBF_{subsystem}$ is known, and $MTBF_{red\ system}$ is unknown, then let $t = MTBF_{subsystem}$, therefore:

$$e^{-(1\ /\ MTBF_{red\ system})\ MTBF_{subsystem}} = 1 - (1 - e^{-(1\ /\ MTBF_{subsystem})\ MTBF_{subsystem}})^N$$

or, $e^{-(1\ /\ MTBF_{red\ system})\ MTBF_{subsystem}} = 1 - (1 - e^{-1})^N$

Since we are solving for $MTBF_{red\ system}$ take the natural log:

$$(-MTBF_{subsystem} / MTBF_{red\ system}) = \ln\{1 - (1 - e^{-1})^N\}$$

or, $MTBF_{red\ system} = (-MTBF_{subsystem}) / [\ln\{1 - (1 - e^{-1})^N\}]$

Therefore, calculated MTBF for redundant system is $(-MTBF_{subsystem}) / [\ln\{1 - (1 - e^{-1})^N\}]$ where N = number of systems in parallel and $MTBF_1 = MTBF_2 = \ldots. = MTBF_N = MTBF_{subsystem}$

3.2 Provisioning Parts Lists (PPL)

Table 3-2 gives the preliminary provisioning parts list for the ORDA retrofit equipment. The LRU level has not been finalized; however, major points to consider are:

- Host computer card, RCP08 card, receiver card, G4 CPU card, and single board computer card use a common single board computer and are physically interchangeable.
- RCP08/Host Computer Assembly and RVP8 Assembly use a common, interchangeable chassis power supply and chassis

Part Description	Mfr Part Number	Unit	National Stock Number	MTBF (hrs)
Router	**TBD**	**TBD**	**TBD**	**250,000**
Flat Panel Monitor	**TBD**	**TBD**	**TBD**	**50,000**
Keyboard	**TBD**	**TBD**	**TBD**	**400,000**
Mouse	**TBD**	**TBD**	**TBD**	**2,000,000**
RCP08/Host Computer Assembly	**TBD**	**TBD**	**TBD**	**25,000**
Host computer card	TBD	TBD	TBD	270,000
RCP08 card	TBD	TBD	TBD	270,000
Chassis power supply	TBD	TBD	TBD	50,000
Chassis Backplane	TBD	TBD	TBD	500,000
Hard drive	TBD	TBD	TBD	300,000
Flash card	TBD	TBD	TBD	1,000,000
CD read/write	TBD	TBD	TBD	60,000
RVP8 Assembly	**TBD**	**TBD**	**TBD**	**43,000**
Receiver card	TBD	TBD	TBD	270,000
G4 CPU card	TBD	TBD	TBD	270,000
Single board computer card	TBD	TBD	TBD	270,000
Chassis power supply	TBD	TBD	TBD	50,000
Chassis Backplane	TBD	TBD	TBD	500,000
IFD	**TBD**	**TBD**	**TBD**	**125,000**

Table 3-2. ORDA retrofit equipment provisioning parts list (preliminary).

4 Maintainability

4.1 Goal

Maintainability will identify Operational Site-level and Depot-level maintenance and support requirements.

4.2 Objectives

Table 4-1 tabulates the requirements for each maintenance function. The X's indicate which requirement affects each maintenance function. Subsequent sections describe the requirements and the strategy to achieve them.

	ORDA Technical Manual (includes diagnostic procedures, disassembly/ installation instructions, calibration, preventive maintenance schedule)	ORDA Training	Depot Repair Documentation (Instructions for diagnosing, repairing, & certifying; drawings; bill-of-material)	Specifications For Vendor's Test Equipment (will probably be included in Depot Repair Documentation)	Determine Remove/Replace LRU-level For Each Maintenance Function	Determine LRU stock-level at Site (on-site spares) and Depot (to protect availability)	Mean Time To Repair	Logistics & Administrative Delay Time (a.k.a., Turnaround Time)	Built-in-Test Training: Isolate faults to 1 LRU for 80% of encountered faults	Built-in-Test Training: Isolate faults to 3 LRUs for 95% of encountered faults	Built-in-Test Training: Isolate faults to 1 LRU for 95% of encountered faults
Operational Site	X	X		X	X	X	X	X	X	X	
NLSC				X		X		X			
NRC	X	X	X	X	X	X		X			X
Hotline	X	X					X		X	X	
Regional/MAGCOM Support	X	X				X	X		X	X	

Table 4-1. Requirements table for Operational Site- and Depot-Level Maintenance functions. To understand the chart, NLSC will be used as an example to illustrate how **Table 4-1** works. The Xs indicate NLSC will need Specifications For Configuring Existing Test Equipment, Determine LRU stock-level, and Logistics & Administrative Delay time.

4.2.1 ORDA Technical Manual

The Contractor will provide technical manuals that define (1.) diagnostic procedures for troubleshooting equipment installed at the Operational Site, (2.) disassembly and installation instructions for removing and replacing equipment installed at the

Operational Site, (3.) calibration instructions, and (4.) preventive maintenance schedule. The ORDA Technical Manual Plan has the list of affected technical manuals and how technical manuals will be developed. Operational Site- and Depot-level maintenance will be included at all stages of technical manual development.

4.2.2 ORDA Training

The Contractor will train the trainers. The trainer is the NWS and Air Force Training Centers. They will train the remaining maintenance functions and operators.

4.2.3 Depot Repair Documentation

The Contractor will provide more detailed documentation such as schematics, Gerber files, vendor-created diagnosing/repair/certification instructions, and supplementary bill-of-materials to NRC. The detailed documentation addresses NRC's requirements for overhauling and repairing equipment down to the lowest possible LRU level.

4.2.4 Specifications For Vendor's Test Equipment

The Contractor will provide specifications regarding the vendor's test equipment and how they use it to test boards. The NRC and NLSC will be able to use these specifications to modify their test equipment and generate new test instructions. These specifications will probably be included with the Depot Repair Documentation.

4.2.5 Determine Remove/Replace LRU-level

The Contractor will work with the Government on determining what equipment will be replaced and repaired by the Operational Site and Depot. This plan proposes following LRU maintenance level options (additional options could be added):

Option 1:

- Operational Sites will replace the RVP8 Assembly, RCP08/Host Computer Assembly, IFD, Router, Monitor, Keyboard, and Mouse and return defective components and assemblies to NRC for additional troubleshooting and repair
- NRC will diagnose returns from Operational Sites and replace the components that make up the RVP8 Assembly and RCP08/Host Computer Assembly. NRC sends defective components (e.g., boards) to vendors for repair/replacement.
- Vendor repairs or replaces components, but the NRC could eventually repair components (e.g., boards) after the warranty expires.

Option 2

- Operational Sites will replace IFD, Router, Monitor, Keyboard, Mouse, and components that make up RVP8 Assembly and RCP08/Host Computer assemblies.

- NRC will diagnose returns from Operational Sites and send defective components to vendors for repair/replacement.
- Vendor repairs or replaces components, but the NRC could eventually repair components (e.g., boards) after the warranty expires.

4.2.6 Determine LRU Stock-Level

During deployment, the Depot-level maintenance functions will use the Government's sparing model to determine the sparing level needed to protect the Operational Sites.

The Contractor's spares will protect the deployment schedule. After the last Operational Site has been deployed, the Contractor will transfer their spares to the NLSC.

The Operational Site sparing level is dependent upon the decision regarding LRU remove and replace level. A determination will be made after the Provisioning Conference.

The Contractor will standardize components and use only COTS equipment, components, and cables. Many of the RVP8 Assembly and RCP08/Host Computer Assembly boards use the same COTS design (only software and firmware will be different). Furthermore, the RVP8 Assembly and RCP08/Host Computer Assembly will use the same chassis.

4.2.7 Mean Time To Repair

The Contractor will design the subsystem to be accessible and rack-mounted. The use of plug-in boards and standard one-to-one (a.k.a. straight-through) cables will be employed. All these design features will reduce the time to disassemble, replace, and re-install components. Commercial software that has a twelve-year track record will constantly monitor the system's health and automatically isolate, solve, and alert personnel of problems.

Figure 4-1 shows the factors that will be considered when evaluating Mean Time To Repair. Mean Time To Repair is based upon corrective maintenance cycle. Fault detection starts the Mean Time To Repair clock, and the clock stops once the repaired equipment has been properly configured and performance verified.

Figure 4-2 illustrates how uptime and downtime are allocated. The times under consideration are (1.) corrective maintenance which is being used as the metric for Mean Time To Repair, and (2.) Logistics and Administrative Delay Time. Logistics and Administrative Delay Time is discussed in the subsequent section.

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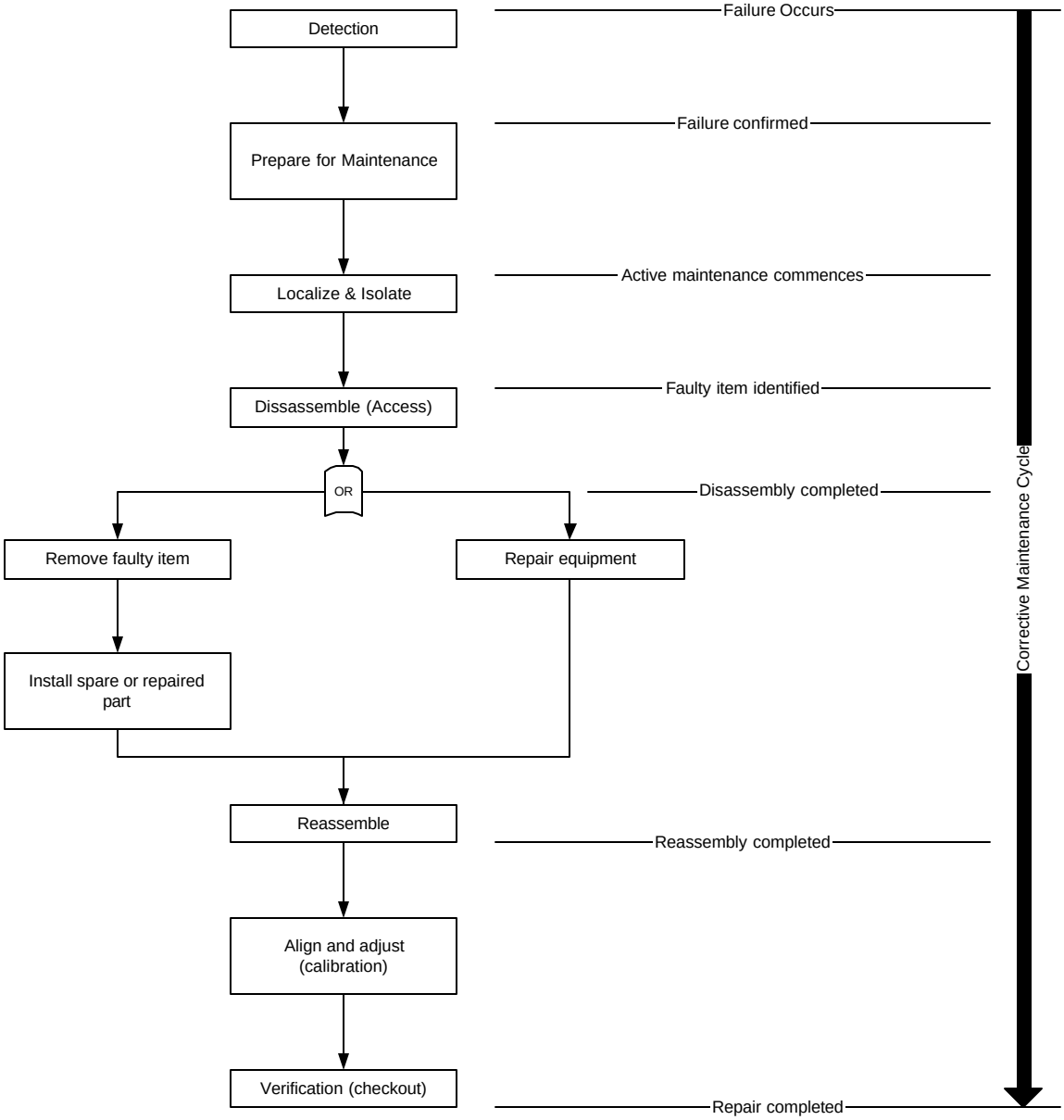

Figure 4-1. Mean Time To Repair cycle (Blanchard, B.S., Logistics Engineering And Management, 5th Ed., Prentice Hall, Inc., Upper Saddle River, N.J., 1998.)

4.2.8 Logistics & Administrative Delay Time

Logistics and Administrative Delay time requirements are dependent upon agreements regarding LRU remove/replacement level and LRU stock-level. Since COTS equipment is being employed, Vendor Item Drawings (a list of suggested vendors) will be available in Agile. Source Control Drawings limits the number of vendors to one, and use of this type of drawing will be minimized (these drawings will also be available in Agile). The Contractor will provide Vendor Item Drawings, Source Control Drawings, and an Illustrated Parts Breakdown.

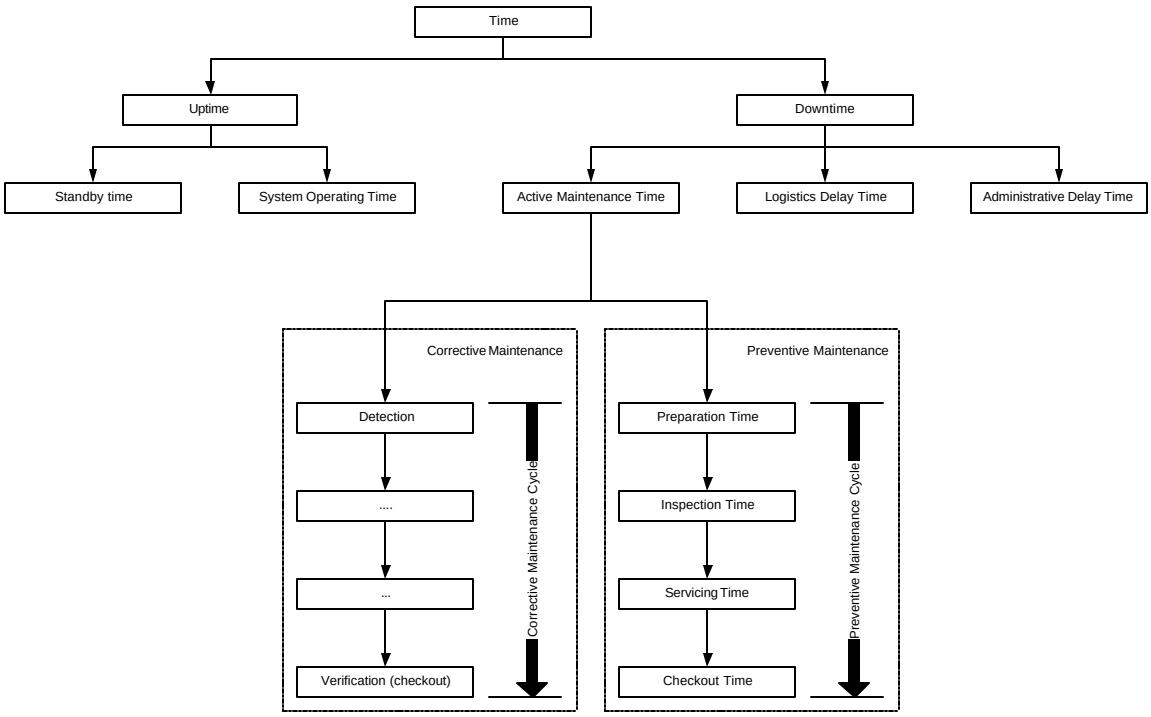

Figure 4-2. Time allocation for uptime and downtime (Blanchard, B.S., Logistics Engineering And Management, 5th Ed., Prentice Hall, Inc., Upper Saddle River, N.J., 1998.)

4.2.9 Built-In-Test Training

The Contractor will provide documentation to the NWS Training Branch and Air Force Training Branch that will help them teach personnel how to isolate faults to 1 LRU for 80% of all encountered faults and 3 LRUs for 95% of all encountered faults using the ORDA retrofit equipment's built-in diagnostics.

The Contractor will provide vendor-created documentation that will enable the NRC to isolate faults to 1 LRU for 95% of all encountered faults.

4.3 Process

Maintainability analyses' objective is to identify Operational Site and Depot maintenance and support requirements during (1.) ID design weaknesses, (2.) standardize/use open systems. These requirements will be refined during (1.) interchangeability assessment, (2.) maintenance assessment, (3.) assembly assessment, and (4.) obsolescence assessment. The actual design will be refined during (1.) PPL continuous improvement, (2.) LRU-level continuous improvement, (3.) Calibration continuous improvement, and (4.) Diagnostics and Trouble-shooting continuous improvement. **Figure 4-3** illustrates the maintainability process.

Maintainability requirements will be expresses in terms of operations and maintenance task requirements described by the guidance documents.

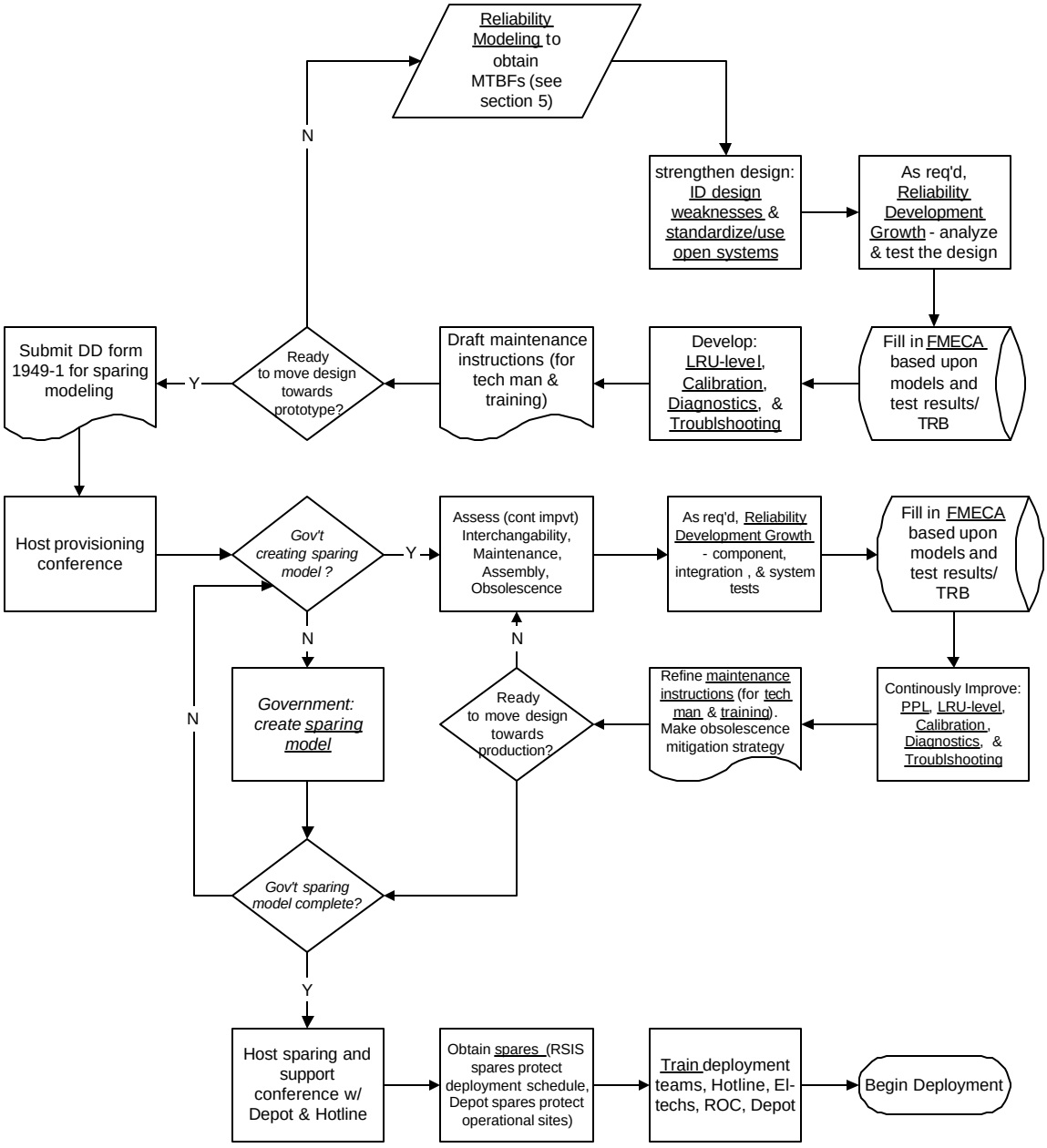

Figure 4-3. Maintainability process.

5 Availability

5.1 Goals

Normally, the availability process would describe how the availability requirements will be validated. However, the System Specification (NEXRAD Technical Requirements) 2810000 revision D does not provide adequate information for allocating availability requirements among the functional areas (i.e., RDA, RPG, PUP), much less the subsystems that make up the functional areas. Therefore, ORDA will not work towards validating availability; instead, we will focus on improving reliability.

5.2 Guidance

- System Specification (NEXRAD Technical Requirements) 2810000 revision D
- "2810000D – Section 3.2.5.3 (Inherent Availability)," 14 August 2002 e-mail from Dr. Joe Manora, Principal Configuration Management Analyst, Radar Operations Center, Program Branch

5.2.1 2810000D – Section 3.2.5.3 (Inherent Availability) email

Subject: Re: 2810000D - Section 3.2.5.3 (Inherent Availability)
Date: Wed, 14 Aug 2002 11:56:24 -0500
From: "Joe Manora" <Joe.Manora@noaa.gov>
Organization: US DOC/NOAA/NWS/NEXRAD OSF
To: "Gabriel W. Jim" <Gabriel.W.Jim@noaa.gov>
CC: "Stephanie K. Heaps" <Stephanie.K.Heaps@noaa.gov>,
Roland Leatherman <Roland.Leatherman@noaa.gov>
References: 1

Gabe:
The Ai reference is to the WSR-88D System as a whole. Therefore, the Ai for the WSR-88D is the the summation of the Ai(RDA)) +Ai(RPG)) +Ai(PUP)). The Ai formula can be derived from the Ao formula located in Section 3.2.5.2 of the SS. the Ai formula is the Ao formula with the TPM (Total Preventive Maintenance Time) and ALDT (administrative and Logistics Delay Time) factors omitted.

Ai for the RPG and PUP Functional Areas is calculated from historical data that exists in the NWS EMRS, using the Ao data to derive Ai. Remember that Ao (Operational Availability) is used to calculate Mean Time Between Failure (MTBF) values (see SS paragraph 3.2.3). For new COTS item, MTBF values usually come from your trade and market studies for the hardware items selected for the system.

With that said, the main challenge for the ORDA Team is to ensure that the MTBF values for the RDA Functional Area is achieved in so far as possible (All functions listed under the RDA Functional Area in Table 3-5). You should not concern yourself with the RPG and PUP Ai values other than to consider them in meeting or testing the system-level Ai requirements if tasked. However, in order to ensure that the WSR-88D system Ai is met, the ORDA team would have to test the entire WSR-88D System as a whole. I don't think your team has been or will be tasked to do that.

Since the ORDA will be comprised of legacy RDA components (for which historical data exists in EMRS) and new COTS components, your system designers must use both historical MTBF data and new MTBF data from the vendor(s) to arrive at the stated WSR-88D system MTBF goals (stated in SS 3.2.5.1). Refer to DOD Handbook 3235.1-H for more detail.

Let me know if you have any more questions.

Dr. Joe Manora <Joe.Manora@noaa.gov>
Principal Configuration Management Analyst
Radar Operations Center – Program Branch

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"Gabriel W. Jim" wrote:

Joe,
I'm not certain how to interpret object ID #SS29731, so I'm going to ask if you can help me interpret it.

Let me start off by stating my interpretation of the previous object ID, SS23084. In SS23084, it states "WSR-88D System components of the RDA functional areas shall (1) have an Ai of at least 0.993 for system functions listed in Table 3-5." Taking object ID SS23084 in context with SS29731, I presume this to mean that the RDA functional area Ai will be 0.993 minimum for (1) NWS, (2) NWS redundant, and (3) DOD (this information isn't explicitly stated in 2810000D, instead, I had to use2830013 to fill in the gaps).

However, object ID #SS239731 states "and for redundant DOT WSR-88D Systems the Ai shall (2) be 0.998 or higher." This object makes no reference to RDA, RPG, or PUP functional areas, it only makes reference to the WSR-88D System. Therefore, am I to presume this to mean the DOT WSR-88D System is to have an Ai of at least 0.998? If so, how do I calculate RDA functional area Ai since I don't have any data regarding RPG and PUP Ai, or do I take the 1/3rd root of Ai = 0.998 to derive RDA functional area Ai?

Thanks.

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6 Revision

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